CLAIMS

1. An acoustic telemetry apparatus for communicating digital data from a down-hole location through a borehole to the surface or between locations within the borehole, said apparatus comprising a receiver and a transmitter separated by an acoustic channel wherein the acoustic channel has a cross-sectional area of 58 cm^2 or less and the transmitter comprises an electro-active transducer generating a modulated continuous waveform.

2. The acoustic telemetry apparatus of claim 1 wherein the waveform is modulated to transmit the data.

3. The acoustic telemetry apparatus of claim 1 the waveform is modulated to transmit encoded data comprising the results of more than one or two different types of measurements.

4. The acoustic telemetry apparatus of claim 1 wherein the cross-sectional diameter of the acoustic channel is 25 cm^2 or less.

5. The acoustic telemetry apparatus of claim 1 wherein the acoustic channel is a column of liquid extending from the surface to a down-hole location.

6. The acoustic telemetry apparatus of claim 5 wherein the acoustic channel is a continuous liquid-filled tubing string temporarily suspended in the borehole.

7. The apparatus of claim 5 wherein the acoustic

channel is a tubular control line permanently or quasi-permanently installed in the borehole.

8. The apparatus of claim 7 wherein the acoustic channel is a tubular control line permanently or quasi-permanently installed in the well bore providing simultaneously hydraulic control to a down-hole installation.

9. The acoustic telemetry apparatus of claim 5 wherein the column of liquid has a viscosity of less than 3×10^{-3} NS/m^2.

10. The acoustic telemetry apparatus of claim 1 further comprising an acoustic source installed at the surface and a receiver installed at the down-hole location to enable two-way communication through the acoustic channel.

11. The acoustic telemetry apparatus of claim 1 further comprising a signal processing device adapted to filter the reflected wave signals or other noise from the upwards traveling modulated wave signals.

12. The acoustic telemetry apparatus of claim 1 wherein the waveform has narrow-band of less than +/- 10 percent half-width deviation from a nominal frequency.

13. The acoustic telemetry apparatus of claim 1 wherein the waveform is preferable a sinusoidal wave.

14. The acoustic telemetry apparatus of claim 1 wherein the transducer comprises piezo-electric material.

15. Use of the apparatus of claim 1 in a well stimulation operation.

16. A method of communicating digital data from a down-hole location through a borehole to the surface comprising the steps of:

establishing a column of liquid as acoustic channel through said borehole, said column having a cross-sectional area of 58 cm^2 or less;

generating at the down-hole location an acoustic wave carrier signal within said acoustic channel using an electro-active transducer;

modulating amplitude and/or phase of said carrier wave in response to a digital signal; and

detecting at the surface the modulated acoustic waves traveling within said acoustic channel.

17. The method of claim 16 further comprising the steps of performing measurements of down-hole parameters, encoding said measurements into a bitstream; and controlling the transducer in response to said encoded bitstream.

18. The method of claim 16 further comprising the step of selecting the frequency of the carrier wave in the range of 0.1 to 100Hz.

19. A method of stimulating a wellbore comprising the steps of

performing operations designed to improve the production of said wellbore while simultaneously establishing from the surface to a down-hole location a column of liquid as acoustic channel through said borehole;

generating at the down-hole location an acoustic wave carrier signal within said acoustic channel using an electro-active transducer;

modulating amplitude and/or phase of said carrier wave in response to a digital signal; and

detecting at the surface the modulated acoustic waves traveling within said acoustic channel..

20. The method of claim 19 wherein the step of establishing from the surface to a down-hole location a column of liquid as acoustic channel comprises the step of lowering a small-diameter coiled tubing string into the borehole

21. An acoustic telemetry apparatus for digitally communicating from the surface to a down-hole location through a borehole or between locations within the borehole, said apparatus comprising an acoustic source installed at the surface separated by an acoustic channel from a receiver installed at the down-hole location, wherein the acoustic channel has a cross-sectional area of 58 cm^2 or less and the acoustic source comprises an electro-active transducer generating a modulated continuous waveform.

22. The acoustic telemetry apparatus of claim 21, wherein the acoustic source provides operational commands to the down-hole receiver.

23. The acoustic telemetry apparatus of claim 21 wherein the cross-sectional diameter of the acoustic channel is 25 cm^2 or less.

24. The acoustic telemetry apparatus of claim 21 wherein the acoustic channel is a column of liquid extending from the surface to a down-hole location.

25. The acoustic telemetry apparatus of claim 24, wherein the acoustic channel is a continuous liquid-filled tubing string temporarily suspended in the borehole.

26. The acoustic telemetry apparatus of claim 24 wherein the acoustic channel is a tubular control line permanently or quasi-permanently installed in the borehole.

27. The acoustic telemetry apparatus of claim 26 wherein the acoustic channel is a tubular control line permanently or quasi-permanently installed in the well bore providing simultaneously hydraulic control to a down-hole installation.

28. The acoustic telemetry apparatus of claim 24 wherein the column of liquid has a viscosity of less than $3X10^{-3}$ NS/M^2

29. The acoustic telemetry apparatus of claim 21, further comprising a down-hole transmitter and a surface receiver separated by the acoustic channel, wherein the down-hole transmitter is adapted for digital communication with the surface receiver.

30. The acoustic telemetry apparatus of claim 29, wherein the acoustic source installed at the surface communicates with the down-hole receiver in a frequency band that is outside the frequency band of the communication from the down-hole transmitter with the surface receiver.